

logical volume to thereby access said designated logical volume,
said disk controller including:

a memory storing the number of operations requested to each physical disk unit,
for each physical disk unit, and

control means for accessing one of said plurality of physical disk units which
stores the designated logical volume, in accordance with said number of operations,

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wherein said control means compares numbers of operations corresponding to a
plurality of physical disk units which store said designated logical volume with each other,
selects the single physical disk unit from among the disk units storing the designated logical
volume which has a minimum number of operations based on the comparison, and outputs a
request to only the selected single minimum waiting physical disk unit having the minimum
number of operations based on the comparison,

wherein said control means increments the number of operations of said selected
physical disk unit in accordance with a request for said operation and decrements the number
of operations of a physical disk unit whose operation has been completed, in accordance with
an end of said operation,

wherein each of said physical disk units performs requested operations in a queued
order, and

wherein said memory stores a table indicating the plurality of physical disk units and a
status information of said logical volume corresponding to each of said logical volume and
status information indicating statuses of said physical disk units; and said control means refers
to said memory with said designated logical volume, judges whether or not said status
information of logical volume indicates abnormal and selects said single physical disk unit on
which said designated logical volume is allocated by said comparison of the operation numbers
when a plurality of physical disk units storing copies of said designated logical volume are
normal from said status information of said logical volume and selects a normal physical disk
unit among said plurality of physical disk units indicated by the status information of said logical
disk units when said status information indicates abnormal.

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7. (AS EIGHT TIMES AMENDED) An access control method for a RAID apparatus
comprising a plurality of physical disk units storing a plurality of copies of each of logical
volumes, and a disk controller accessing any physical disk unit which stores a designated
logical volume to thereby access said designated logical volume, said method comprising:

determining a plurality of physical disk units which store a designated logical volume;
and

selecting from among the determined disk units storing the designated logical volume one of said determined physical disk units in accordance with the number of operations requested to said physical disk units, said selecting comprising:

comparing said numbers of operations of a plurality of physical disk units which store said designated logical volumes with each other,

accessing the single physical disk unit which has a minimum number of operations based on the comparison and outputting a request to only said selected waiting physical disk unit having the minimum number of operations based on the comparison,

incrementing the number of operations of said accessed physical disk unit in accordance with a request for said operation, and

decrementing the number of operations of a physical disk unit whose operation has been completed, in accordance with an end of said operation,

wherein each of said plurality of physical disk units performs requested operations in a queued order, and

wherein said selecting further comprises referring to a memory storing a table indicating the plurality of physical disk units and a status information of said logical volume corresponding to each of said logical volume and status information indicating statuses of said physical disk units, judging whether or not said status information of logical volume indicates abnormal, and

selecting said physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume are normal from said status information of said logical volume and selecting a normal physical disk unit among said plurality of physical disk units indicated by the status information of said logical disk units when said status information indicates abnormal.

13. (AS EIGHT TIMES AMENDED) A RAID apparatus comprising:

physical disk units storing redundant logical volumes, a first of the redundant logical volumes being stored on one of the physical disk units, and a second of the redundant logical volumes being stored on another of the physical disk units; and

a disk controller counting numbers of operations respectively requested of each of the physical disk units and accessing one of the first and the second of the redundant logical

volumes based on a minimum number of the numbers of operation respectively requested of each of the physical disk units storing the redundant logical volumes based on the counting, and outputting a request to only the accessed single physical disk unit having the minimum number of operations based on the comparison,

I₃ wherein said disk controller increments the number of operations of an accessed physical disk unit in accordance with a request for said operation and decrements the number of operations of an accessed physical disk unit whose operation has been completed, in accordance with an end of said operation,

wherein each of said physical disk units performs requested operations in a queued order, and

wherein said disk controller refers to a table indicating the plurality of physical disk units and a status information of said logical volume corresponding to each said redundant logical volumes and status information indicating statuses of said physical disk units; judges whether or not said status information of logical volume indicates abnormal; selects said single physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume are normal from said status information of the logical volume and selects a normal physical disk unit among said plurality of physical disk units indicated by the status information of said logical disk units when said status information indicates abnormal.

I₄ 14. (AS SEVEN TIMES AMENDED) A RAID controller accessing one of a plurality of physical disk units storing a plurality of copies of each of logical volumes to thereby access a designated logical volume, comprising:

a memory storing a number of operations requested of each physical disk unit corresponding to each physical disk unit; and

a controller comparing said numbers of operations corresponding to a plurality of physical disk units which store a designated logical volume with each other, and selecting single one of said plurality of physical disk units which has a minimum number of operations from among the plurality of physical disk units storing the designated logical volume based on the comparison and outputting a request to only said selected single physical disk unit having the minimum number of operations based on the comparison,

wherein said controller increments the number of operations of said selected physical

disk unit in accordance with a request for said operation and decrements the number of operations of a physical disk unit whose operation has been completed, in accordance with an end of said operation, wherein each of said plurality of physical disk units performs requested operations in a queued order, and

wherein said memory stores a table indicating a plurality of physical disk units and a status information of said logical volume corresponding to each of said logical volume and status information indicating statuses of said physical disk units; and said designated logical volume; judges whether or not said status information of logical volume indicates abnormal and said status information of logical volume indicates abnormal selects said single physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume are normal from said status information of the logical volume and selects a normal physical disk unit among said plurality of physical disk units indicated by the status information of said logical disk units when said status information indicates abnormal.

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15. (AS SEVEN TIMES AMENDED) A balancing access method for a RAID apparatus comprising a plurality of physical disk units storing a plurality of copies of each of logical volumes, comprising:

comparing numbers of operations of a plurality of physical disk units which store a designated logical volume with each other;

selecting a single one of said physical disk units which has a minimum number of operations from the disk units storing the designated logical volume based on the comparison and outputting a request to only said selected single minimum waiting physical disk unit;

incrementing the number of operations of said accessed physical disk unit in accordance with a request on said operation; and

decrementing the number of operations of a physical disk unit whose operation has been completed, in accordance with an end of said operation, wherein each of said physical disk units performs requested operations in a queued order, and

wherein said selecting further comprises referring to a memory storing a table indicating the plurality of physical disk units and a status information of said logical volume corresponding to each of said logical volume and status information indicating statuses of said physical disk units; judging whether or not said status information of logical volume indicates abnormal, and

I4 selecting said single physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume are normal from said status information of said logical volume and selecting a normal physical disk unit among said plurality of physical disk units indicated by the status information of said logical disk units when said disk unit among said plurality of physical disk units when said status information indicates abnormal.

17. (AS ONCE AMENDED) The RAID apparatus according to claim 1, wherein said table in the memory comprising:

a logical volume structure table storing statuses and said plurality of physical disk units of each logical volume; and

a disk management table storing statuses and the number of operations of each physical disk unit,

I5 and wherein said control means refers to said logical volume structure table with said designated logical volume, and selects said single physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers in the disk management table when determining that a plurality of physical disk units storing copies of said designated logical volume are normal from said logical volume structure table and selects a normal physical disk unit among said plurality of physical disk units from said disk management table when said status of said designated logical volume indicates abnormal.

18. (AS ONCE AMENDED) The access control method according to claim 7, wherein said referring comprises referring said memory comprising a logical volume structure table storing status of and said plurality of physical disk units of each logical volume and disk management table storing statuses and the number of operations of each physical disk unit,

and wherein said selecting comprising: selecting said single physical disk unit on which said designated logical volume is allocated by said comparison of the operation numbers in the disk management table when determining that a plurality of physical disk units storing copies of said designated logical volume are normal from said logical volume structure table; and selecting a normal physical disk unit among said plurality of physical disk units from said disk management table when said status of said designated logical volume indicates abnormal.

Please ADD new claims 19 and 20 in accordance with the following:

19. (AS NEW) A RAID apparatus comprising:

a plurality of physical disk units storing a plurality of copies of each of logical volumes;
and

a disk controller accessing any of the physical disk units which stores a designated logical volume to thereby access said designated logical volume,

said disk controller including:

a memory having a logical volume structure table storing a status of said plurality of physical disk units of each logical volume, and a disk management table storing statuses and the number of operations of each physical disk unit; and

Ik a control unit which refers to said logical volume structure table with said designated logical volume, judges whether or not said status information of logical volume indicates abnormal and selects said single physical disk unit on which said designated logical volume is allocated by comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume and selects a normal physical disk unit among said plurality of physical disk units indicates by the status information of said logical disk units when said status information indicates abnormal.

20. (AS NEW) A RAID access method for a RAID apparatus comprising a plurality of physical disk units storing a plurality of copies of each of logical volumes, comprising:

referring to a memory storing a table indicating a plurality of physical disk units and a status information of said logical volume corresponding to each of said logical volume and status information indicating statuses and the operation numbers of said physical disk units;

judging whether or not said status information of logical volume indicates abnormal;

selecting a single physical disk unit on which said designated logical volume is allocated by comparison of the operation numbers when a plurality of physical disk units storing copies of said designated logical volume are normal from said status information of said logical volume;
and

selecting a normal physical disk unit among said plurality of physical disk units indicated by the status information of said logical disk units when said status information indicates abnormal.